

# Effects of smokeless tobacco on the blood pressure and pulse rate among Sudanese users: A Cohort study

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## ABSTRACT

**Background:** Use of smokeless tobacco (SLT) and its cardiovascular risk was not well studied among Sudanese. In this study we aim to study the changes in pulse and blood pressure among snuff users. **Methods:** This is a cohort (before and after) study, carried among Sudanese SLT users, with the aim of reviewing its effect on their blood pressure and pulse rate. A questionnaire, with direct interviewing was used to collect data, blood pressure and pulse rate records, initially and after one hour following the use of SLT. **Results:** Out of 100 participants who were all males, their age varied between 20-68, mean 34 years SD 9.36, married 58%, the dominant occupation was students 37%, drivers 21% and farmers 18%. The mean age at start snuffing, was around 16 years. Interestingly, their systolic, diastolic blood pressure and radial pulse rate has increased one hour following the insertion of their usual snuff dose. The mean difference was 11.56 with 12.07 SD for systolic blood pressure, P value (0.001), and 10.73 with 11.29 SD, for the diastolic blood pressure P value (0.001) and 2.32, with 10.20 SD, for the pulse rate P value (0.001). All participants shared the same type and way of use of the SLT. **Conclusion:** This study has shown highly statistically significant increase in the blood pressure and pulse rate after one hour following the use of SLT. With an early start of using SLT among different Sudanese workers.

**Keywords:** Smokeless tobacco, Pulse, Blood pressure, Saffa, Sudan

## 1. INTRODUCTION

Smokeless tobacco is a major health concern, estimated to be around 350 million users worldwide, concentrated particularly in south-east Asia (Mehrotra et al., 2018). Recent national data completed from several large scale studies indicate that 10-12 million Americans use some form of SLT (Christen et al., 1989). The commonest site of insertion of the SLT is inside the mouth beside the cheek or behind the lower or upper lip, Sudanese users mainly use local Nicotianarustica, (a tobacco species with high levels of nicotine and nornicotine), prepared as snuff and they call Toombak. Leaves are fined and mixed with sodium bicarbonate, water is added and a paste of the mixture is made. The "Saffa" (a small piece of this past) is placed into the oral vestibule

where it remains up for many hours. In general, a Saffa is replaced by a new one frequently (10 – 30) per day (Izzaddinn et al., 2020; Idris et al., 1994).

Survey data on the use of Toombak in the Nile province northern Sudan encompass 2,000 households with 5,500 adults has shown high rate of use among adults particularly males with females being very scarce users in particular old women. Smokeless tobacco use was highest among workers in the mining industry (14.3%) and installation, maintenance and repair occupations (9.6%), (Syamlal et al., 2017). The majority of snuff users are men under 45 years. The age at starting is decreasing. Female users are still few, but the number is expected to rise (Natvig et al., 2005).

In regards to the rates of use, they are highest among teenagers and young adult males. While the most popular form of smokeless tobacco is moist snuff, peer pressure and some other factors are correlated closely to one current use of SLT (Johnson et al., 1993; Aldhmadi et al. 2021). Smokeless tobacco (snuff and chewing tobacco) is reemerging as a popular form of tobacco, particularly among male adolescents. In different regions of the United States, from 8 to 36 percent of male high-school students are regular users (Connolly et al., 1986). In the United States SLT use has increased over the last two decades, it is thought to be largely due to increased consumption by young people (Johnson et al., 1993). Tolerance develops with repeated use, causing the user to increase nicotine dosing through increased use and or switching to products with higher nicotine yields (Henningfield et al., 1997).

In a study by Jain et al., (2021) 30,395 (3.38%) individuals Compared with non-users, have found smokeless tobacco users are more likely to be unmarried, male, Caucasian, belonging to the lower socioeconomic strata, and did not have a formal college education. Besides being a concern in young people for the later development of dependence on cigarettes, a major concern in young males is also the accelerated coronary artery disease (Benowitz et al., 1988). Studies has attributed SLT effects on the cardiovascular system are to be due to chronic systemic exposure to nicotine, which could contribute to accelerated coronary artery disease, acute cardiac ischemic events, and hypertension. Systemic absorption of sodium and mutagenic chemicals from smokeless tobacco could aggravate hypertension or cardiac failure, or contribute to cancer, respectively. Data from the few studies performed to date suggest that smokeless tobacco users develop a dependency similar to that for cigarette smokers. Much of the destruction of oral tissues is related to the localization of the tobacco quid; i.e., it is habitually held in only one spot in the mouth (Benowitz et al., 1997).

Some studies have shown sustained levels of nicotine among young males using smokeless tobacco, causing concern for subsequent cardiovascular risk (Allen et al., 1995). It was also supposed that systemic absorption of sodium and mutagenic chemicals from smokeless tobacco could aggravate hypertension or cardiac failure, or contribute to cancer (Benowitz et al., 1997). There is a greater prevalence of hypertension and metabolic syndrome in users of smokeless tobacco. The need for public health and clinical interventions to reduce smokeless tobacco addiction made many researchers to study the effects of smokeless tobacco on the cardiovascular health. Its use is high in countries of South and Southeast Asia, Africa and Northern Europe (Gupta et al., 2013).

## 2. METHODOLOGY

This is a cohort (before and after study) conducted among 100 Sudanese male smokeless tobacco users, in Wadmedani City, Sudan, during the period from June to August 2020. A random sampling technique was used to enroll the participants from different sites in Wadmedani City. Simple random size was calculated to be 100. A structured questionnaire was used to collect information from participants including demographic data, pulse rate and blood pressure records, pre and post SLT. All participants were enrolled in a full clinical history as well as full physical examination. Patients with vascular disorders or heart diseases, renal failure or liver disease were excluded. Participants blood pressure and pulse rates were measured before and after the insertion of the usual Saffa (Smokeless tobacco small dose around 5 grams inserted in the area of use), followed by measurement of the radial pulse and arm blood pressure after one hour. The statistical package for social sciences (SPSS, version 16, New York) was used for data analysis. Data was described first, then paired T test was used for the assessment of the effects of SLT on pulse and blood pressure before and after use. P-value of  $< 0.05$  is considered significant. Ethical approval was obtained from the research ethics committee of the faculty of medicine, university of Tabuk (No READ0091). All the participants signed written informed consent.

## 3. RESULTS

The total number of participants agreed to be tested and met the criteria of inclusion in this study were 100 male adults, all of them were Sudanese. The study was carried out in Wadmedani city, the capital of Gezira state, Sudan. Their age varied between 20 and 68 years, the mean age is 33.65 with 9.36 standard deviation (SD) from the mean. The minimum age at starting the use of smokeless tobacco (SLT) was 10 and the maximum age was 33, with a mean age of 16.43 and 3.46SD from the mean. There were 58 % married

participants, occupations varied between students as the highest percentage among the study group 37%, drivers 21%, farmers 18%, teachers 9%, workers 8%, merchants 6% and doctors 1%, (Table 1). We found 8 % of the participants are asthmatics and are using bronchial asthma inhaler treatment on demand, and 2 % are diabetics on anti-diabetics with the vast majority are on no chronic medications 90 %, (Table 1).

All of the participants use the Sudanese type of SLT, inside the mouth behind the lower lip or cheek, at a dose of about 5 grams. They have high frequency of use with minimum frequency of 9 times per day and maximum 75 times per day with a mean of 21.83 and 8.81 SD from the mean, (Table 1).

**Table 1** Descriptive data among the study population

Factor	Number	Minimum	Maximum	Mean	Standard Deviation (SD)
Age	100	20	68	33.65	9.36
Age at start	100	10	33	16.43	3.46
Frequency of use	100	9	75	21.83	8.81
Factor	Frequency			Percent	
Married	58			58.0 %	
Occupation					
Student	37			37.0 %	
Driver	21			21.0 %	
Farmer	18			18.0 %	
Merchant	6			6.0 %	
Worker	8			8.0 %	
Teacher	9			9.0 %	
Doctor	1			1.0 %	
Chronic diseases					
No chronic diseases	90			90.0 %	
Bronchial asthma	8			8.0 %	
Diabetes	2			2.0 %	
Not on treatment	90			90.0 %	
On bronchial asthma treatment	8			8.0 %	
On anti-diabetic	2			2.0 %	

The arm blood pressure was measured in the morning before the participant use of his daily dose of snuff and considered as the basic blood pressure, followed by another records one hour later. Initially, the minimum systolic blood pressure record was 80 mm Hg, while the maximum was 190 mm Hg, with a mean record of 126.67 mm Hg and 13.90 mm Hg SD. The minimum diastolic blood pressure record was 50 mm Hg, the maximum record was 136 mm Hg with a mean record of 97.54 mm Hg and 17.75 mm Hg SD. The minimum pulse rate record was 60 beats/min and the maximum was 180 beats/min, with a mean record of 75.64 beats/min and 14.58 beats/min SD (Figure 1).

The minimum systolic blood pressure record 1 hour after the use of SLT was 100 mm Hg. The maximum among the study group was 196 mm Hg, with a mean record of 138.23 mm Hg and 12.46 mm Hg SD. While the minimum diastolic blood pressure record was 60mm Hg, the maximum record was 142 mm Hg with a mean record of 108.27 mm Hg and 17.48 SD. The minimum pulse rate record after the use of SLT was 60 beats/min, the maximum was 104 beats/min with a mean record of 77.96 beats/min and 10.49 beats/min SD (Table 2) and (Figure 1).

**Table 2** Descriptive statistics of the blood pressure and pulse measurements before and after the use of SLT

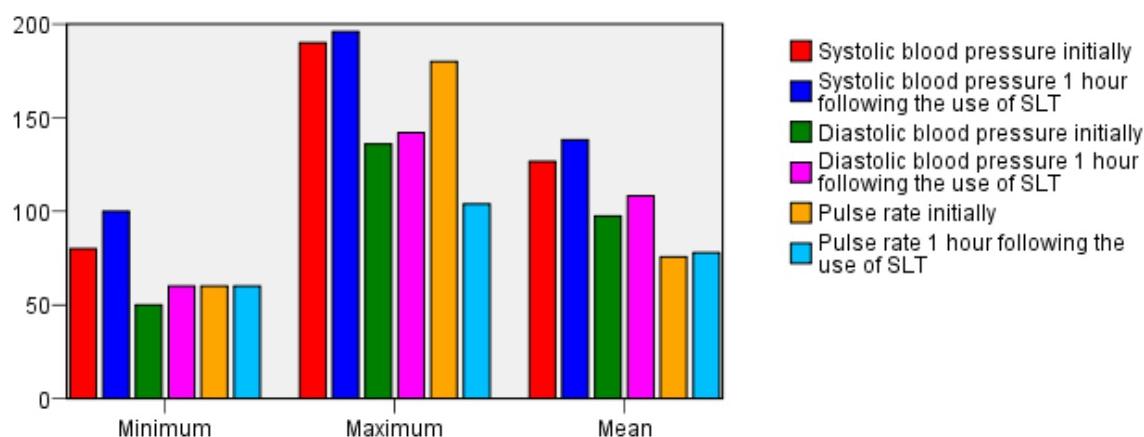
Value	Minimum	Maximum	Mean	Standard Deviation
Systolic blood pressure initially	80	190	126.67	13.90
Systolic blood pressure 1 hour following	100	196	138.23	12.46

the use of SLT				
Diastolic blood pressure initially	50	136	97.54	17.75
Diastolic blood pressure 1 hour following the use of SLT	60	142	108.27	17.48
Pulse rate initially	60	180	75.64	14.58
Pulse rate 1 hour following the use of SLT	60	104	77.96	10.49

On the paired T test for the systolic blood pressure differences before and after the use of SLT between the two groups, a significant rise in the blood pressure was observed. The mean systolic blood pressure on average was 126.67 before use and 138.23 after the use with a (Mean difference = 11.56, SD = 11.29, 95 % CI = 13.80, 9.32, P value < 0.001) (Table 3). On the paired T test of the diastolic blood pressure differences before and after the use of SLT between the two groups, also a significant rise was observed. The mean diastolic blood pressure on average was 97.54 before use and 108.27 after the use with a (Mean difference = 10.73, SD = 12.07, 95 % CI = 13.13, 8.34, P value < 0.001) (Table 3). Also The radial pulse differences between the two groups before and after the use of the snuff was also studied on the paired T test, and a significant difference was observed showing an increase in the pulse rate from a mean of 75.64 on average before use and 77.96 after the use of SLT, with a (Mean difference = 2.32, SD = 10.20, 95 % CI = 4.34, 0.30, P value < 0.001) (Table 3).

**Table 3** Paired statistical T tests analysis results of the systolic blood pressure, diastolic blood pressure, and pulse rate records initially and one hour following the use of SLT.

Factor	Paired Differences				P value	
	Mean	SD	Standard Error Mean	95% Confidence Interval of the Difference		
				Lower	Upper	
Systolic blood pressure before and after one hour of the use of SLT	11.56	11.29	1.13	13.80	9.32	0.001
Diastolic blood pressure before and after one hour of the use of SLT	10.73	12.07	1.207	13.13	8.34	0.001
Pulse rate before and after one hour of the use of SLT	2.32	10.20	1.02	4.34	0.30	0.001



**Figure 1** Descriptive statistics of the blood pressure and pulse measurements before and after the use of SLT

## 4. DISCUSSION

Smokeless tobacco is now a real health challenge not only in Sudan but also worldwide. We aimed at this study to examine its effects on the cardiovascular system, through testing its effects on both the pulse rate and blood pressure if any changes are made among Sudanese users. 100 male participants were enrolled in this study, all were Sudanese. We found that most of them were adults with a mean age of 33.65 (Table 1), this is consistent with other studies in the fact that most of SLT users are males and adults (Syamlal et al., 2017; Natvig et al., 2005; Johnson et al., 1993).

Most of the participants have started using SLT earlier in their life. The minimum age at starting the use among the study group was 10 years, and the maximum age was 33 years, with a mean age of 16 years, this is coinciding with the available data showing that the age at starting the use of SLT is decreasing (Natvig et al., 2005). Around 58% of the study population were married, with high percentage of use among single adults, here it is also consistent with other studies in being common among unmarried males. In a study conducted in a round thirty thousand users in America the rate of use, was more common among male unmarried users (Jain et al., 2021). In the current study with regards to occupations, their occupations varied between students (as the highest percentage) 37%, drivers 21%, farmers 18%, teachers 9%, workers 8%, merchants 6% and doctors 1%, (Table 1). An American study has revealed a higher use of SLT among workers (Miners, installation, maintenance and repair) this is comparable to our study results showing a considerable use among workers and farmers 58%, Drivers 21% and low percentage of use, among merchants and teachers, and very low percentage of use among professionals like doctors (Syamlal et al., 2017). In this study not only healthy people are found to be using the SLT but also people with chronic disease. While around 8 % of the participants are asthmatics and are using bronchial asthma inhaler treatment on demand and 2 % are diabetics and on anti-diabetics, the vast majority are on no chronic medications 90 %, (Table 1).

Compared to a KSA study, showing a common use of SLT inside the mouth either behind the cheek or lower lip (Izzaddinn et al., 2020), all of the participants are using the Sudanese type of SLT, in their country which they call Toombak, where a small piece is taken by the user, they give it the name Saffa. Saffa is inserted inside the mouth, usually behind the lower lip or inside one cheek. Around 5 grams are inserted in each single dose. All of the participants have high frequency of use of Saffa, with a minimum frequency as to be 9 times per day and the maximum frequency of use is 75 times per day, with a mean of around 22 times per day and 8.81 SD from the mean, (Table 1). This is similar to what was found in a large study, conducted in western Sudan (Idris et al., 1994) showing high frequency of repeating the Saffa per day. This high frequency of use, for such quite long time, renders the users as tolerant and dependent to SLT. Compared to other studies, mostly similar figures were observed (Jain et al., 2021; Benowitz et al., 1988).

Several studies in different areas of the world has shown that chronic systemic exposure to nicotine could contribute to accelerated coronary artery disease, acute cardiac ischemic events and hypertension. However, no published studies up to the time of conduction of the current study, in Sudan were found in SLT in regards to its cardiovascular risk. In this study, the arm blood pressure was measured in the morning before the participant use of their usual dose of snuff (Saffa). We considered this as the basic blood pressure, followed by another records one hour after use (Saffa insertion). A mean systolic blood pressure record of 126.67 with 13.90 SD, from the mean, and a mean diastolic blood pressure record of 97.54 with 17.75 SD and a mean pulse rate record of 75.64 with 14.58 SD, were initially recorded. Those basic records were followed by another record one hour late. We observed a rise in both pulse and blood pressure. The mean differences were ,138.23 with 12.46 SD for the systolic blood pressure, 108.27 with 17.48 SD for the diastolic blood pressure and 77.96 with 10.49 SD for the pulse rate, respectively, (Table 2), indicating a considerable change of increment in the three cardiovascular signs under test.

Of interest and on the paired statistical testing of both blood pressure components as well as the pulse rate, between the two groups (before and after the use of the snuff), a significant statistical difference was observed on the paired T test, showing highly statistical significant for each of the three components ( $P$  value  $<0.001$ ), (Table 3). This is comparable to similar researches in this field, where studied the effects of SLT cardiovascular risk, they found significant changes in the cardiovascular system and its clinical markers, including the pulse rate and blood pressure on systemic SLT use, we can conclude that SLT use among Sudanese, could contribute to significant changes in the cardiovascular system as it has shown significant statistical significances on the blood pressure and the pulse rate among the participants, (Benowitz et al., 1988; Benowitz et al., 1997; Gupta et al., 2013).

## 5. CONCLUSION

Despite the rarity of studies in this field in Sudan, this study has shown a high rate of use of smokeless tobacco among young unmarried adults, with highly statistical significant increase in systolic and diastolic blood pressure as well as the pulse rate after one hour following the use of SLT, pointing towards a significant effect in the cardiovascular system.

**Recommendation**

Large case control studies, including female users and addressing many cardiac features and markers are needed to study this health concern among Sudanese SLT users.

**Funding**

This study has not received any external funding.

**Conflict of Interest**

The authors declare that there are no conflicts of interests.

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**Informed consent**

Written & Oral informed consent was obtained from study participants.

**Ethical approval**

Ethical approval was obtained from the research ethics committee of the faculty of medicine, university of Tabuk (No; READ 0091).

**Author's contribution**

First author: The concept, design, data analysis manuscript drafting and approval.

Second Author: The concept, design, data collection manuscript drafting and approval.

**Data and materials availability**

All data associated with this study are present in the paper.

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